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AMENDMENTS TO CLAIMS:

The listing of claims below will replace all prior versions, and listings, of claims in the application.

LISTING OF CLAIMS:

1. (Currently Amended) A method for improving resolution of a digital representation having a plurality of text or graphics pixels, comprising the steps of:

identifying a text or graphics pixel on a boundary of a text or graphics object of the digital representation; and

for each text or graphics pixel identified as on the boundary

tracing a group of pixels, including the initial boundary-identified pixel, that constitute a local boundary segment and constructing ~~a chain code~~an identifier indicative of the number and relative locations of the pixels of that local boundary segment;

parameterizing and smoothing that local boundary segment, resulting in a new local boundary segment, by ~~accessing~~ computing instructions ~~stored in a look up table~~ for parameterizing and smoothing that local boundary segment ~~using the constructed chain code as an index to the look up table~~; and

rendering the parameterized and smoothed boundary segment to ~~improve~~ increase the resolution of the text or graphics object.

2. (Currently Amended) The method of claim 1, wherein the instructions are pre-computed, stored in a look-up table, indexed by the corresponding identifier, and directly accessed during the parameterizing and smoothing of that local boundary segment~~tracing step comprises searching and identifying each new pixel in the group with respect to a background neighbor pixel that is propagated from a penultimate identified pixel to a just identified pixel~~.

3. (Canceled)

4. (Currently Amended) The method of claim ~~2~~3, wherein the tracing step comprises identifying first and second contiguous sub-groups of pixels, each starting with the initial pixel and extending in first and second directions

respectively relative to the propagated background neighbor pixel and, if available, a just-identified pixel in that sub-group to construct the ~~chain-code~~identifer.

5. (Currently Amended) The method of claim ~~2~~3, wherein the tracing step comprises tracing N pixels in a first direction and N pixels in a second direction to construct the ~~chain code~~identifier based on a pre-determined set of rules used in the tracing step.

6. (Currently Amended) The method of claim 2, wherein the stored instructions on parameterizing and smoothing comprise a differential stored at a location in the pre-computed look-up table indexed by the corresponding ~~chain-code~~identifier, the differential representing a difference between the location of at least one pixel in the new local boundary segment and the location of that pixel in the corresponding un-parameterized and un-smoothed local boundary segment.

7. (Currently Amended) The method of claim 2, wherein the stored instructions on parameterizing and smoothing comprise general occupancy information stored at a location in the pre-computed look-up table indexed by the corresponding ~~chain code~~identifier, the general occupancy information representing a difference between the location of the new local boundary segment and the location of the corresponding un-parameterized and un-smoothed local boundary segment.

8. (Original) The method of claim 1, wherein the identifying step comprises identifying each text and graphics pixel on a boundary of a text or graphics object of the digital representation, and performing the tracing, parameterizing and smoothing, and rendering for each boundary-identified pixel.

9. (Currently Amended) An apparatus for improving resolution of a digital representation having a plurality of text or graphics pixels, the apparatus comprising:

means for identifying a text or graphics pixel on a boundary of a text or graphics object of the digital representation; and

means for tracing a group of pixels, including an initial boundary-identified pixel, that constitute a local boundary segment and constructing ~~a chain code~~an identifier indicative of the number and relative locations of the pixels of that local boundary segment;

means for parameterizing and smoothing that local boundary segment to generate a new local boundary segment by ~~accessing~~ computing instructions ~~stored in a look-up table~~ for parameterizing and smoothing that local boundary segment ~~using the constructed chain code as an index to the look-up table~~; and

means for rendering the parameterized and smoothed boundary segment to ~~improve~~ increase the resolution of the text or graphics object.

10. (Currently Amended) The apparatus of claim 9, wherein the instructions are pre-computed, stored in a look-up table, indexed by the corresponding identifier, and directly accessed during the paramterizing and smoothing of that local boundary segment~~means for tracing comprises means for searching and identifying each new pixel in the group with respect to a background neighbor pixel that is propagated from a penultimate identified pixel to a just identified pixel~~.

11. (Canceled)

12. (Currently Amended) The apparatus of claim ~~10~~34, wherein the tracing means is configured to identify first and second contiguous sub-groups of pixels, each starting with the initial pixel and extending in first and second directions respectively relative to the propagated background neighbor pixel and, if available, a just-identified pixel in that sub-group to construct the ~~chain-code~~identifier.

13. (Currently Amended) The apparatus of claim ~~10~~34, wherein the tracing means is configured to trace N pixels in a first direction and N pixels in a second direction to construct the ~~chain-code~~identifier.

14. (Currently Amended) The apparatus of claim 10, wherein the stored instructions on parameterizing and smoothing comprise a differential stored at a location in the pre-computed look-up table indexed by the corresponding ~~chain-~~

~~code~~identifier, the differential representing a difference between the location of at least one pixel in the new local boundary segment and the location of that pixel in the corresponding un-parameterized and un-smoothed local boundary segment.

15. (Currently Amended) The apparatus of claim 10, wherein the stored instructions on parameterizing and smoothing comprise general occupancy information stored at a location in the pre-computed look-up table indexed by the corresponding ~~chain code~~identifier, the general occupancy information representing a difference between the location of the new local boundary segment and the location of the corresponding un-parameterized and un-smoothed local boundary segment.

16. (Original) The apparatus of claim 9, wherein the identifying means is configured to identify each text and graphics pixel on a boundary of a text or graphics object of the digital representation, and wherein the tracing, parameterizing and smoothing, and rendering means are each configured to operate on each boundary-identified pixel.

17. (Currently Amended) A machine-readable medium having a program of instructions for directing a machine to improve resolution of a digital representation having a plurality of text or graphics pixels, the program of instructions comprising:

instructions for identifying a text or graphics pixel on a boundary of a text or graphics object of the digital representation; and

for each text or graphics pixel identified as on the boundary

instructions for tracing a group of pixels, including the initial boundary-identified pixel, that constitute a local boundary segment and constructing ~~for a chain code~~an identifier indicative of the number and relative locations of the pixels of that local boundary segment;

instructions for parameterizing and smoothing that local boundary segment, resulting in a new local boundary segment, by ~~accessing~~ computing directions ~~stored in a look-up table~~ for parameterizing and smoothing

that local boundary segment ~~using the constructed chain code as an index to the look up table~~; and

instructions for rendering the parameterized and smoothed boundary segment to ~~improve~~ increase the resolution of the text or graphics object.

18. (Currently Amended) The machine-readable medium of claim 17, wherein the directions are pre-computed, stored in a look-up table, indexed by the corresponding identifier, and directly accessed during the parameterizing and smoothing of that local boundary segment~~tracing instructions comprises instructions for searching and identifying each new pixel in the group with respect to a background neighbor pixel that is propagated from a penultimate identified pixel to a just identified pixel~~.

19. (Canceled)

20. (Currently Amended) The machine-readable medium of claim ~~18~~35, wherein the tracing instructions comprises identifying first and second contiguous sub-groups of pixels, each starting with the initial pixel and extending in first and second directions respectively relative to the propagated background neighbor pixel and, if available, a just-identified pixel in that sub-group to construct the ~~chain code~~identifier.

21. (Currently Amended) The machine-readable medium of claim ~~18~~35, wherein the tracing instructions comprises instructions for tracing N pixels in a first direction and N pixels in a second direction to construct the ~~chain code~~identifier based on a pre-determined set of rules used in the tracing.

22. (Currently Amended) The machine-readable medium of claim 18, wherein the stored directions on parameterizing and smoothing comprise a differential stored at a location in the pre-computed look-up table indexed by the corresponding ~~chain code~~identifier, the differential representing a difference between the location of at least one pixel in the new local boundary segment and the location of that pixel in the corresponding un-parameterized and un-smoothed local boundary segment.

23. (Currently Amended) The machine-readable medium of claim 18, wherein the stored directions on parameterizing and smoothing comprise general occupancy information stored at a location in the pre-computed look-up table indexed by the corresponding ~~chain code~~identifier, the general occupancy information representing a difference between the location of the new local boundary segment and the location of the corresponding un-parameterized and un-smoothed local boundary segment.

24. (Original) The machine-readable medium of claim 17, wherein the identifying instructions comprises identifying each text and graphics pixel on a boundary of a text or graphics object of the digital representation, and performing the tracing, parameterizing and smoothing, and rendering for each boundary-identified pixel.

Claims 25-32 (Canceled)

33. (New) The method of claim 1, wherein the tracing step comprises searching and identifying each new pixel in the group with respect to a background neighbor pixel that is propagated from a penultimate-identified pixel to a just-identified pixel.

34. (New) The apparatus of claim 9, wherein the means for tracing comprises means for searching and identifying each new pixel in the group with respect to a background neighbor pixel that is propagated from a penultimate-identified pixel to a just-identified pixel.

35. (New) The machine-readable medium of claim 17, wherein the tracing instructions comprises for searching and identifying each new pixel in the group with respect to a background neighbor pixel that is propagated from a penultimate-identified pixel to a just-identified pixel.

REMARKS

Claims 1, 2, 4-10, 12-18, 20-24 and 33-35 are pending. Each of the independent claims (1, 9 and 17) has been amended to refocus the invention.

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The feature of the parameterizing and smoothing instructions being pre-computed, stored in a look-up table, indexed by the corresponding identifier, and directly accessed during the parameterizing and smoothing has been removed from each of the independent claims, as this feature is not needed to establish patentability of those claims. This feature is now contained in each of dependent claims 2, 10 and 18. As a result, the tracing feature that was recited in each of those dependent claims has been deleted therefrom and is now embodied in each of new dependent claims 33-35. The dependencies of claims 4, 5, 12, 13, 20 and 21 have been changed accordingly. Regarding further amendments to the independent claims, the limitation of "chain-code" has also been removed from each; the original and broader term "identifier" has been reinstated. This change has been propagated through the dependent claims as well. Each independent claim has been further amended to indicate that the parameterized and smoothed boundary segment is rendered to increase the resolution of the object of which the segment is a part.

Each of the presently pending independent claims (1, 9 and 17), as well as dependent claims 8, 16 and 24, have been rejected under 35 U.S.C. § 103(a) based on U.S. patent 5,537,495 to *Overton* in view of U.S. patent 4,777,651 to *McCann et al.* (*McCann*). The Examiner contends that *Overton* generally discloses a pixel correction and smoothing method to improve the resolution of a digital representation. *McCann* is cited as teaching the details recited in claims 1, 9 and 17. Applicants respectfully traverse this rejection.

The shortcomings of *Overton* as applied to applicants' claimed invention was discussed in some detail in applicants' previously-filed Amendment A. In short, *Overton's* method of improving the rendering of a pixel pattern, does not involve identifying text or graphics boundary pixels. More importantly, he neither discloses nor teaches the tracing, identifier constructing and parameterizing aspects of applicants' invention, as set forth in claims 1, 9 and 17.

McCann does not overcome the deficiencies of *Overton*. McCann's process involves converting a bit-map image of a picture to vectors as the document on which the picture is contained is scanned. In the course of this process, the bit-

map image is manipulated to form a series of windows, each containing a set number of pixels. The windows of pixels are serially examined, and based on the pattern of light and dark pixels within the window, the center pixel is changed from dark to light, from light to dark, or left unchanged. A corresponding number associated with a given window pixel pattern identifies it as one of the possible patterns and provides a table-look up instruction to determine what change, if any, to make to the center pixel. This operation applied to windows centered at each pixel, performs all image transformation of growing, smoothing, thinning and noise elimination of the bit-map image.

The line and edge features of the resulting bit-map representation are partitioned into line segments, each of which is chain-coded and temporarily stored, as it is acquired, in an ordered list. When storage of each chain-coded segment is completed, the segment is converted to vectors and transmitted to a user device for display, storage or further processing. The process continues until the entire document has been scanned and converted to vector data.

A careful comparison between *McCann's* process and applicants' invention reveal that they are quite different. To begin with, *McCann's* input-to-output conversion is a lossy compression process which means that information is lost. This is an intended consequence of *McCann's* process (which includes removal of spurious points) and one that is directly at odds with applicants' invention which involves resolution, and hence quality, enhancement. Applicants' invention does not compress; rather, it increases the resolution. In applicants' invention, information is not lost; in fact, information is gained. This point is further emphasized in each of the independent claims by reciting that the rendering of the parameterized and smoothed boundary segment is done to increase the resolution of the text or graphics object.

With the above difference in mind, it is also clear that *McCann's* "smoothing" operation to remove spurious points is completely different from applicants' claimed local boundary segment smoothing. No points are considered "spurious" in the context of applicants' invention. In fact, applicants' invention would process such points and make them look better, not remove them. *McCann's* smoothing is part of a more general operation that also includes

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growing and thinning which is carried out for accurate edge detection. Applicants' invention does not involve edge detection; the locations of the edges are known.

Moreover, *McCann* does not compute parameterizing and smoothing instructions nor does he apply such instructions to a local boundary segment to parameterize and smooth the segment resulting in a new segment. He generates vector data using a chain-code. But before his chain codes are generated, that is, when he is processing the window data, each window is assigned a number that is used to access an instruction in a look-up table to determine whether or not to change the color of the center pixel. That instruction is simply whether to change the color of the center pixel of the given window. The instruction is not for increasing resolution, as each of applicants' independent claims recite.

In view of the foregoing, it is believed that this Response places this application in condition for allowance; its entry is therefore believed to be proper under 37 C.F.R. §1.116. Accordingly, entry of this Response is respectfully requested. Should the Examiner believe that issues remain outstanding, s/he is respectfully requested to contact applicants undersigned attorney in an effort to resolve such issues and advance the case to issue.

Respectfully Submitted,

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